Sea Lion Deterrents at Bonneville Dam: Did They Work?

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Objectives

- Estimate number of adult salmonids and other fish caught
- Record seasonal timing, abundance of sea lions
- Record sea lion behavior, individual habits
- Test measures used to deter sea lion presence and predation on salmon

Observations

- Surface observations during daylight hours
  - One observer per tailrace (PH1, PH2, spillway)
  - Record catches and losses of fish
  - Identify individual sea lions
  - Estimate number of sea lions present at each tailrace
- Randomized, paired-treatment, 4-day (2 days on/off) block design to test effectiveness of hazing and acoustics combination

SLEDs

- Sea lion exclusion devices (SLEDs) installed at fishway entrances
- 12 entrances, 2 sections each, 15 3/8” gaps
- Designed to allow salmon passage

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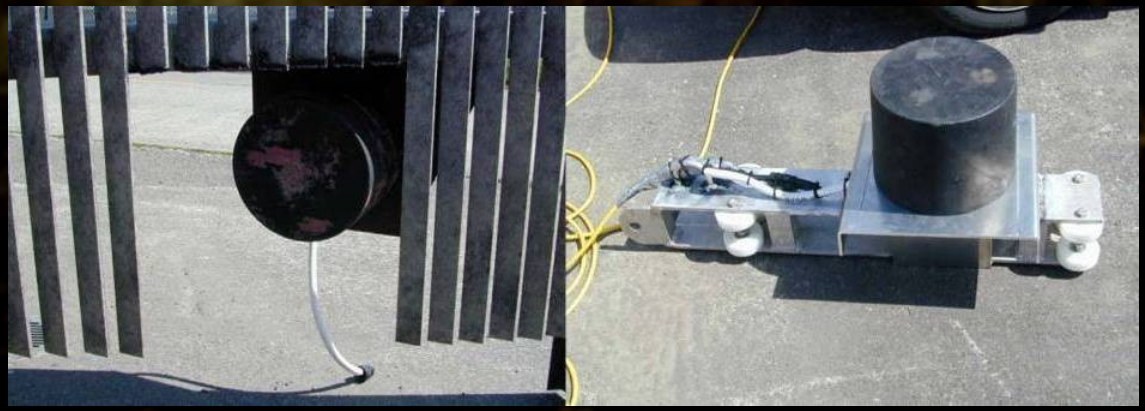
Acoustic Deterrent Devices (ADD)

- 205 decibel, 15 kHz frequency acoustic projectors installed at fishway entrances (March – May 2006)
- Advertised “painful” effective range of 30 ft., and potential effects up to 100 ft.
- ADDs turned on at 0500 hrs on hazing days, turned off at 2000 hrs at the end of each 2-day treatment
- No significant effects on salmon passage



USDA Hazing

- March – May 2006
- USDA APHIS Wildlife Services agents armed with cracker shells, rubber bullets, and screamer shells
- Opportunistically hazed sea lions hauled out and those within 100 ft. of fishways
- Identified hazed sea lions when possible

Boat-based Hazing

- State, federal, and tribal personnel armed with non-lethal hazing pyrotechnics and rubber bullets
- Hazed sea lions in all tailraces to chase them downstream of the dam
- Alternating (non-randomized) 4-day on/off blocks

RESULTS

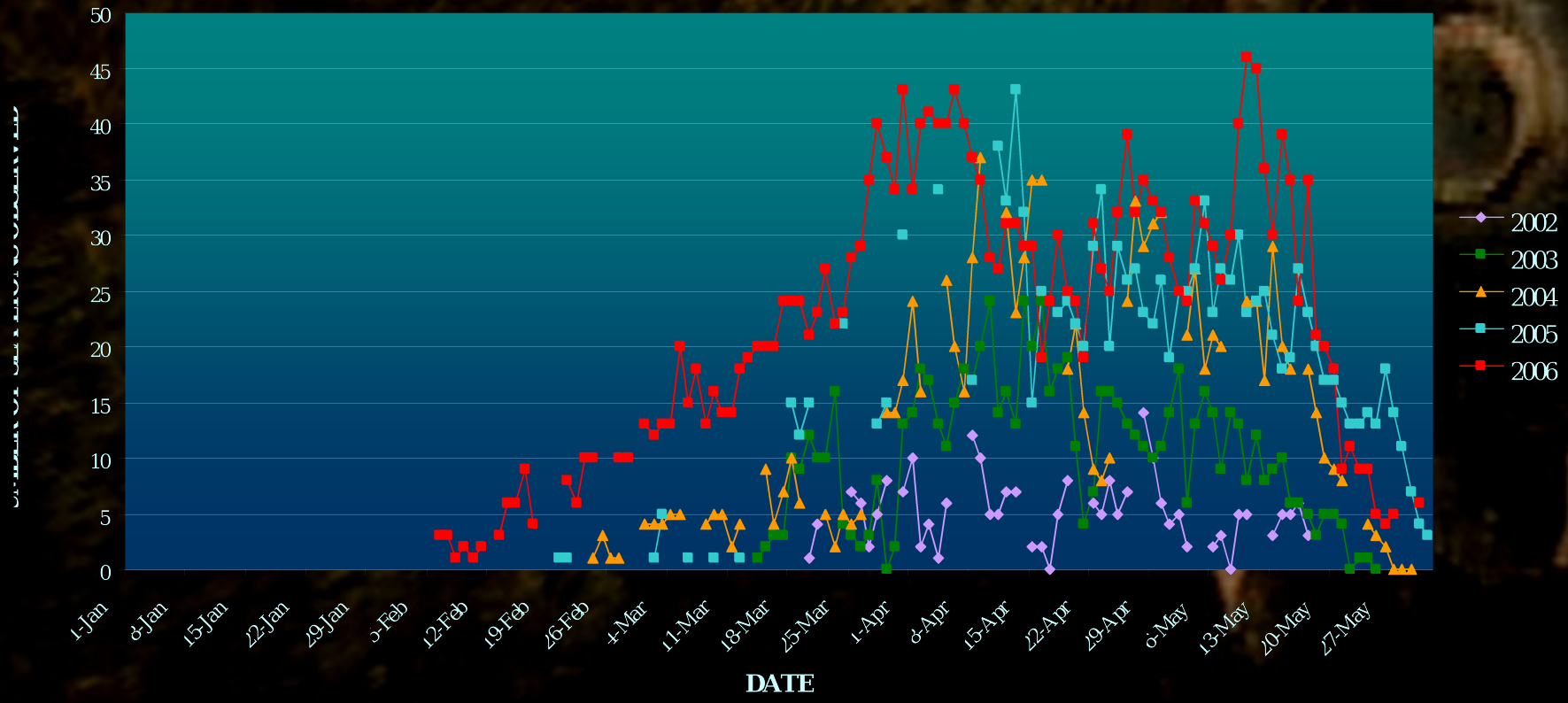
Observed catches by pinnipeds at Bonneville Dam tailrace (2006)

- Chinook (45%)
- Steelhead (7.8%)
- Salmonid (18.8%)
- Lamprey (9.9%)
- Sturgeon (7%)
- Shad (0.8%)
- Other (0.3%)
- Unknown (10.4%)

Estimated salmonid catch by sea lions at Bonneville Dam, 1 January – 31 May

Year	Estimate of Salmonids Caught	Total Salmonid Passage at Bonneville	% of Salmonid Run Taken by Sea Lions
2002	1,010	284,733	0.4%
2003	2,329	217,185	1.1%
2004	3,533	186,804	1.9%
2005	2,920+	82,006	3.4%+
2006	3,023	105,063	2.8%

Seasonal distribution of sea lions at Bonneville Dam, 2002-2006



Estimated pinniped abundance at Bonneville Dam, 2002-2006

	2002	2003	2004	2005	2006
California Sea Lions	30	106	101	80+	72
Steller's Sea Lions	0	3	2	4	10
Harbor Seals	1	2	2	1	3
TOTAL	31	111	105	85+	85

SLEDs

- Infamous C404 passed through SLEDs early
- No other sea lions entered the fishways
- Late arrival of Spring Chinook prompted concerns about potential impact of SLEDs on fish passage
- No significant effect on salmon passage

Acoustics: The Short Story

- No obvious effect on behavior of sea lions within 100 ft. of fishway entrances
- Turbulence near fishway entrances likely reduced effective range of ADDs
- Cannot separate results from hazing because of paired treatment design
- "…combined effects of hazing and ADDs did not impede the passage of radio-tagged adult spring Chinook salmon during 2006." (Jepson et al. 2006)

Hazing: The Short Story

- Rubber bullets were used in 55% of hazing events, cracker shells in 40% of events
- 81% of hazing events involved animals near fishways, 16% of events involved hauled out animals
- Peak hazing activity was in early morning and late afternoon, coinciding with haul out and predation patterns
- Only 7 individuals were hazed more than 5 times
- Maximum number of times an animal was hazed was 21 (C309)

Hazing: The Short Story

- One USDA agent per shift seemed inadequate relative to predation levels
- Most predation (84%) occurred outside 100 ft. of fishway entrances
- Hazing sea lions off haul outs ***may*** increase predation activity (maybe, maybe!)
- Branded sea lions were easiest to identify, and were likely disproportionately represented in hazing tallies
- Hazed sea lions would temporarily leave, then resume activities

USDA Hazing and Acoustics

	ON	OFF	Paired t
Total project salmonid take	1,488	1,177	0.02
Avg. daily pinniped presence	26.8	27.1	0.40
Salmonid take w/in 100’ of entrances	202	232	0.22
Total pinniped activity w/in 100’ of entrances	9,098	12,819	0.002

Boat Hazing

	ON	OFF	Paired t
Total project salmonid take	1,147	1,241	0.33
Avg. daily pinniped presence	29.3	27.3	0.24
Salmonid take w/in 100’ of entrances	183	186	0.47
Total pinniped activity w/in 100’ of entrances	8,870	7,623	0.17

S U M M A R Y

Summary

- ~ 3,023 salmonids (2.8% of run) taken at Bonneville
- California and Steller's sea lions coming earlier, staying longer
- SLEDs seemed to work, didn't impede salmon
- Limited hazing/acoustic deterrence efforts failed to reduce predation on salmonids
- Hazing/ADD combination did not impede salmon passage

2007 Season

- Continue full-time daylight observations
- Start partial observations in January
- SLEDs to be installed by February
- ADDs will be activated in February
- Possibly more intensive and deliberate hazing to occur, dawn to dusk, 7 days/week, February thru May
- Possibly some trapping and branding
- Unlikely any lethal take to be conducted

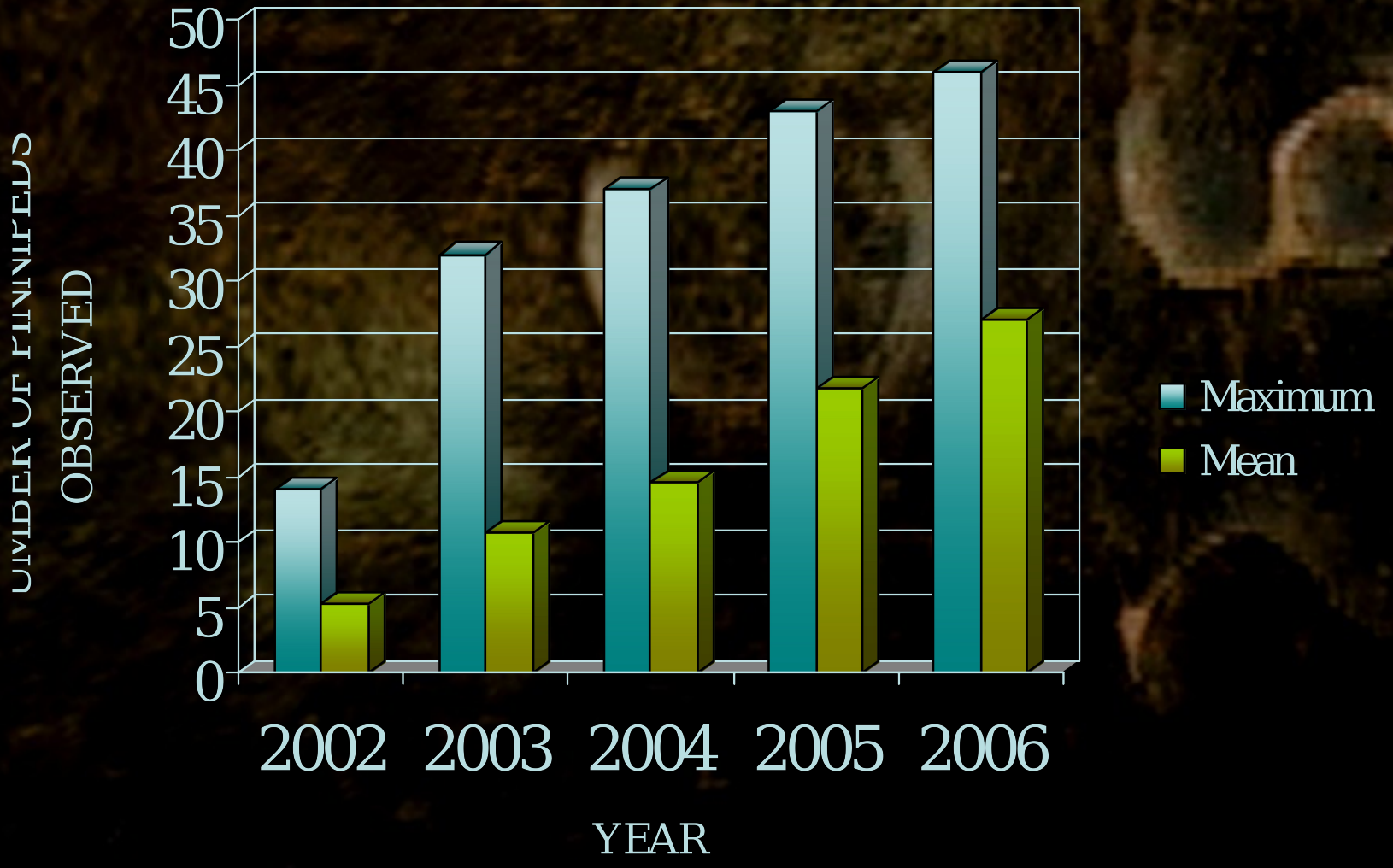
Contributors and Partners

- NOAA Fisheries
- USGS
- USDA APHIS Wildlife Services
- Columbia River Treaty Indian Tribes
- University of Idaho
- Oregon Department of Fish and Wildlife
- Washington Department of Fish and Wildlife

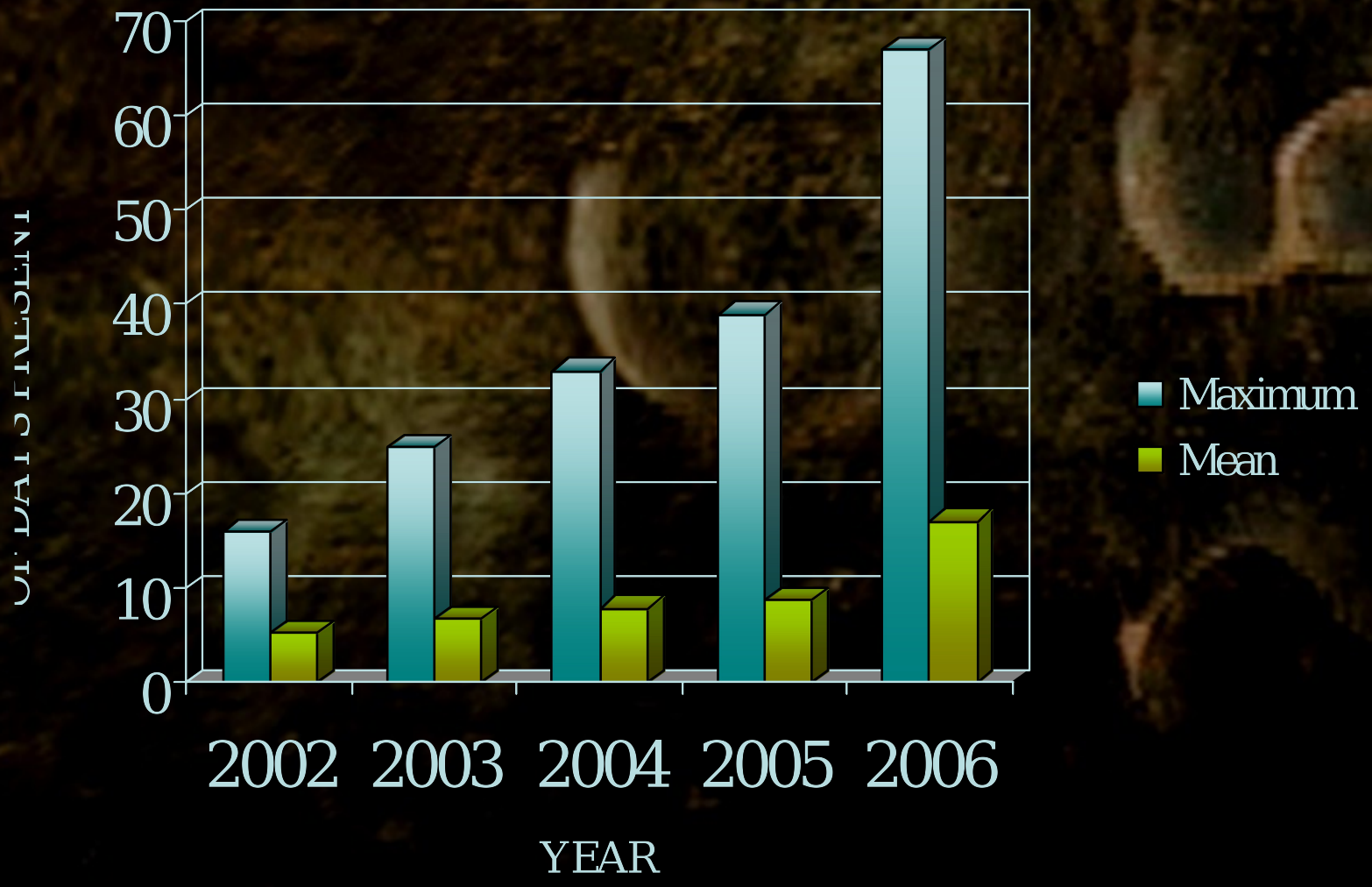
Mmmm
...
I could
go for
some
salmon.

2003
2004
2005
2006
Chinook Salmon
Steelhead
Salmonid
Lamprey
Sturgeon
Shad
Unknown
Other

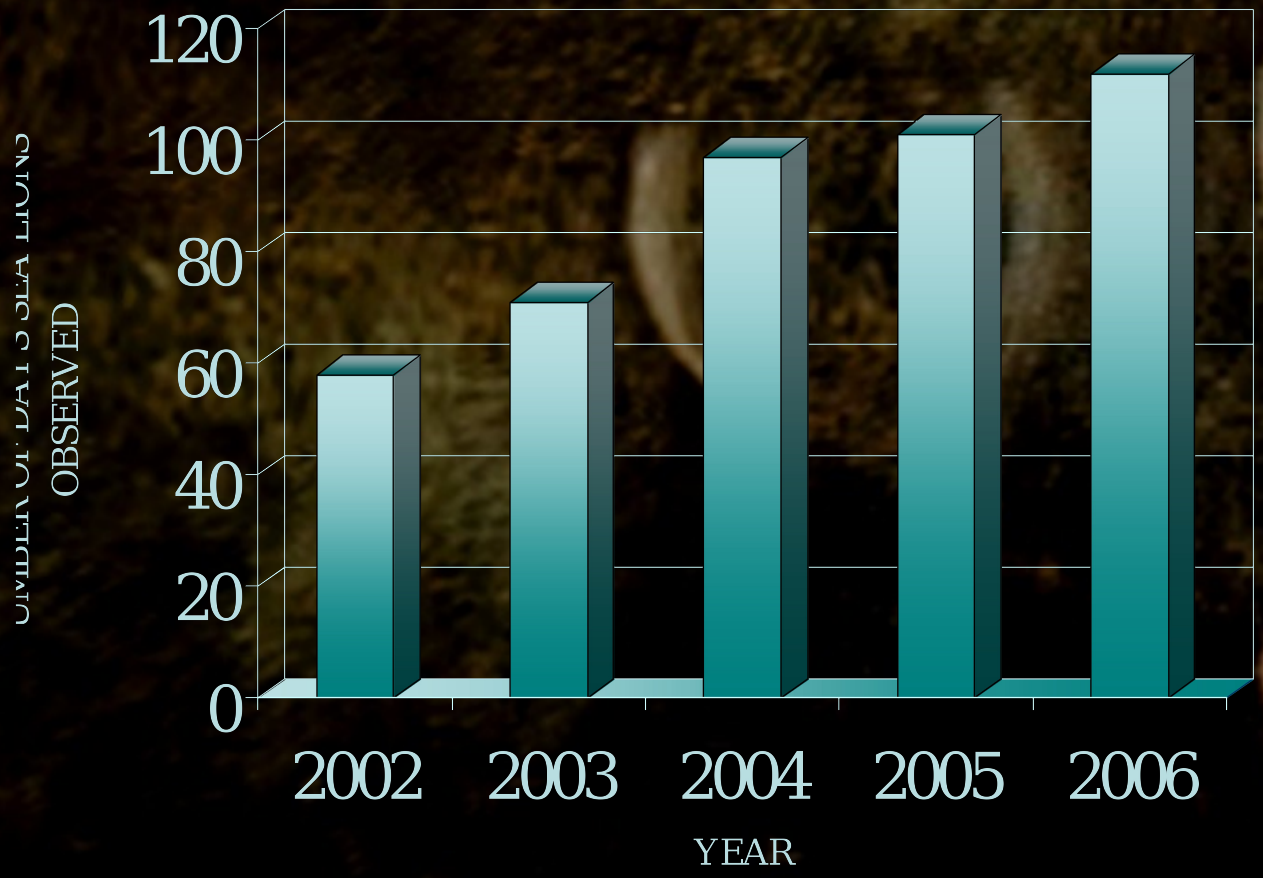
Daily maximum and mean # of pinnipeds observed at Bonneville Dam, 2002-2006



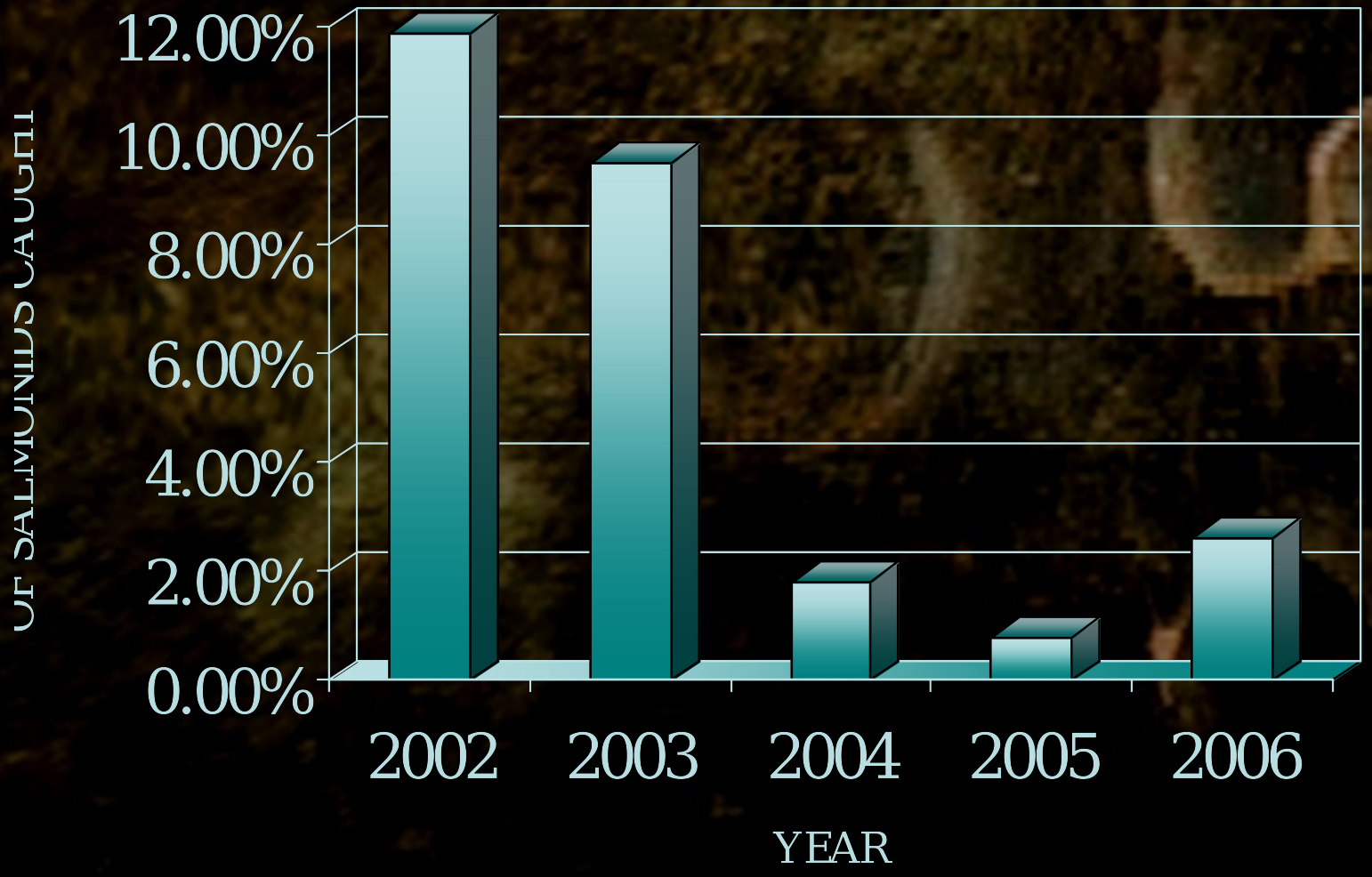
Number of days individual sea lions present, 1 January – 31 May



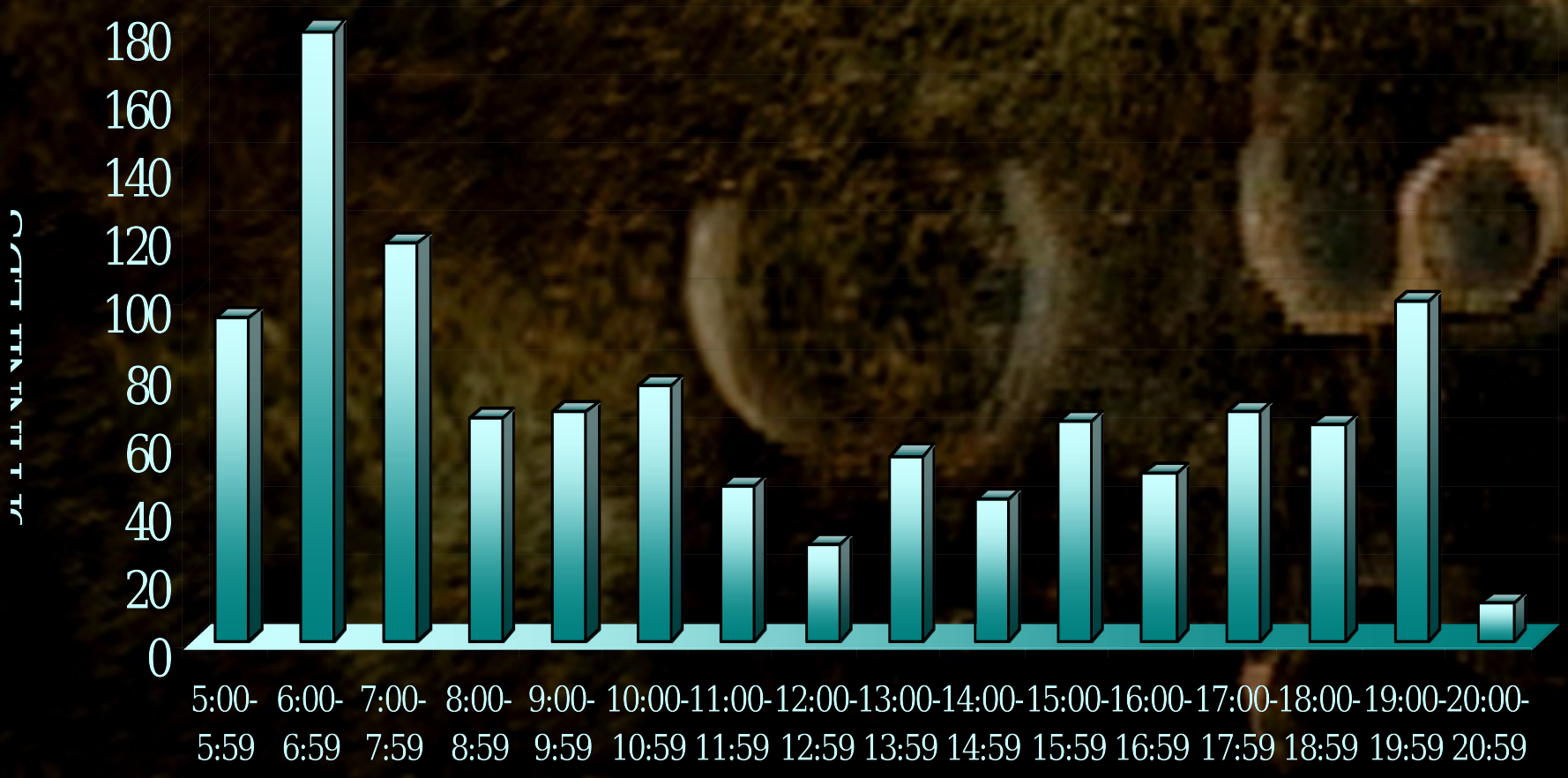
Number of days sea lions observed between 1 January and 31 May, at Bonneville Dam



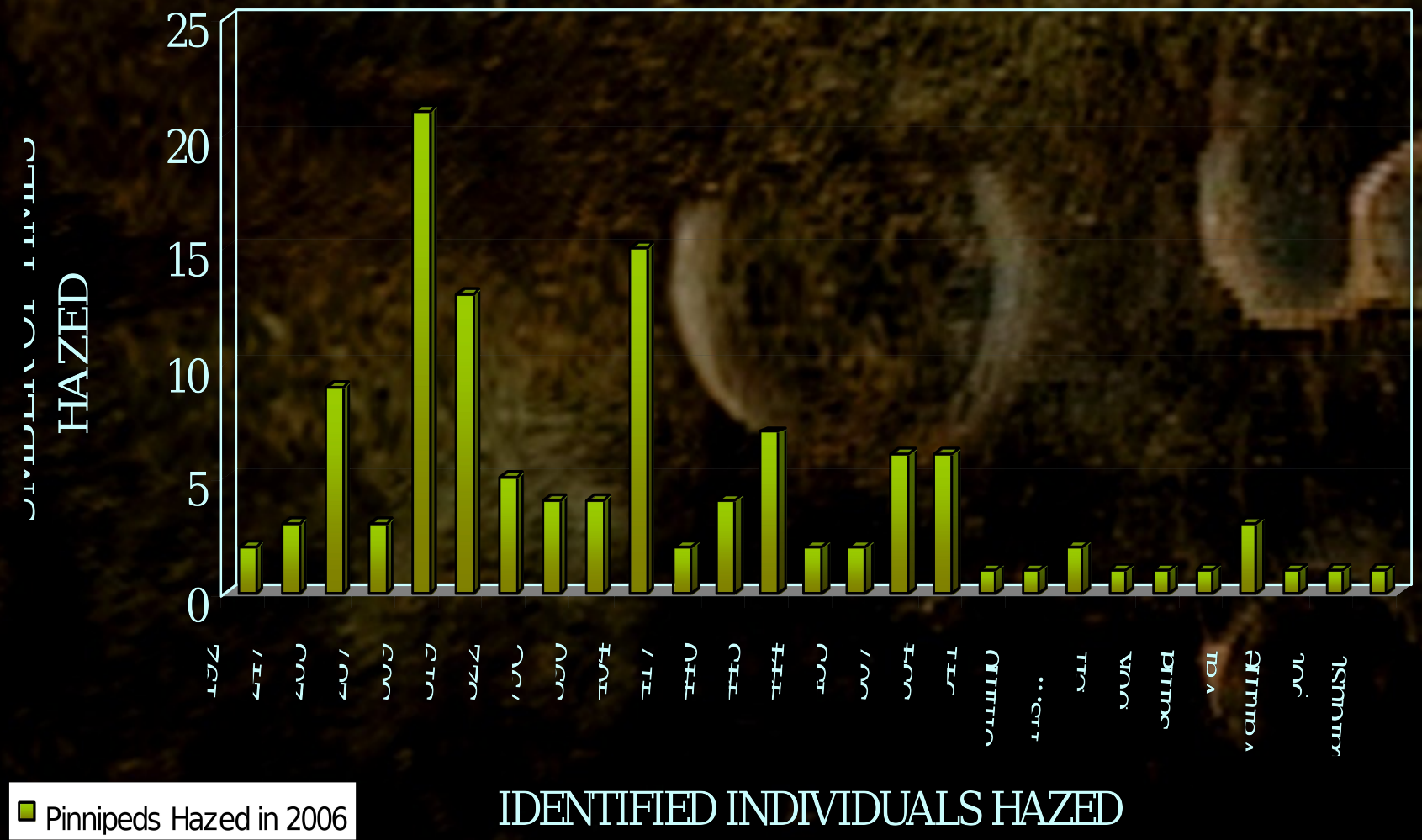
Salmonids that were caught by pinnipeds, but escaped being eaten



Total sea lions hazed per hour - USDA



Hazing frequency, by individual - USDA



Number of highly identifiable sea lions that returned in subsequent years

	2003	2004	2005	2006
2002	81%	75%	56%	38%
2003		59%	42%	26%
2004			61%	38%
2005				57%